



IGS Strategic Plan 2008-2012



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The International GNSS Service provides the highest-quality GNSS data and products in support of the terrestrial reference frame, Earth observations and research, positioning, navigation and timing and other applications that benefit the scientific community and society.

I. Introduction / Executive Summary

The International GNSS Service (IGS), having completed a dynamic period of growth and transition in the 2002 – 2007 timeframe, is pleased to present this new Strategic Plan for the period of 2008 – 2012. The IGS Governing Board anticipates that this upcoming period will be another era of significant changes, as new uses and corresponding increased demands develop for the IGS's suite of data and data products. This Strategic Plan outlines key points of the IGS's fundamental strategy and its anticipated path forward.

The IGS operates as a voluntary scientific federation of more than 200 institutions world-wide, and is self-governed by its members. Each participating organization contributes its own resources: there is no central source of funding.

Since the IGS Governing Board adopted its previous Strategic Plan covering the years 2002-2007, a number of developments have taken place inside and outside the IGS that make it imperative to update the plan. While much of the Strategic Plan 2002-2007 remains valid, this new plan is developed for 2008-2012. The new plan formulates the three key strategies of the IGS:

1. *Deliver world-standard quality GNSS data and products to all users globally with leading-edge expertise and resources*
2. *Develop, integrate, and participate with new and changing GNSS systems and user needs to continuously improve IGS services and to provide value to a broad range of users.*
3. *Continuously improve the effectiveness of IGS management and governance to support future growth*

The broad strategic lines remain as before, but a significant number of the derived actions are new as described in this plan.

IGS' strategic planning process is an ongoing effort. A systematic update of the IGS Terms of Reference and some associated charters for Analysis Centers and Data Centers¹ was completed by the Board. The new version was adopted in March 2005, the first update since 1999. Significant modifications included: a change of the organization's name from "International GPS Service" to "International GNSS Service"; changes to the composition of the Governing Board, including Coordinators for Timing, Reference Frame and Network; and establishment of an IGS Executive Committee.

In parallel with these IGS internal developments, the IGS has been working with the International Association of Geodesy (IAG) and its other scientific services and commissions

¹ (see <http://igsceb.jpl.nasa.gov/organization/orgindex.html>).

on the concept of a Global Geodetic Observing System (GGOS), which is federating the activities and products of the IAG scientific services and commissions and providing the contribution of geodesy to the Global Earth Observing System of Systems (GEOSS). GEOSS is the inter-governmental ad-hoc Group on Earth Observations (GEO), see <http://www.earthobservations.org/index.html>). A central issue of the GGOS initiative is the International Terrestrial Reference Frame (ITRF), its future development, and its correct and consistent use. The IGS, with its prime concern for high accuracy and reliable processing of the signals of the GNSS constellations, and as the provider of the consolidated inputs of the GNSS contribution to the ITRF, necessarily plays a key role in GGOS.

A further new development is the establishment of the International Committee on GNSS (ICG, see www.unoosa.org/oosa/en/SAP/gnss/icg.html). The ICG was officially established through the United Nations Office of Outer Space Affairs (Un-OOSA) in December 2005, following extensive preparatory meetings and actions over several years, in which the IGS played an active role. The members of the ICG are the providers of the GNSS systems, while associate members are mainly inter-governmental and non-governmental organizations which are primarily users of GNSS.

As the foregoing discussion reflects, the IGS is playing a more active role in the international GNSS arena. The field itself is changing rapidly, with the modernization of the GPS system (i.e., the deployment of the GPS IIM, GPS IIF, and GPS III satellites), the revival of the Russian GLONASS (likely to be reestablished as a complete constellation again in the next two years, with additional system developments on the horizon, including a possible move to CDMA signals), the planned European Galileo system of 30 satellites, and global or regional systems being developed by Japan, China and India, among others. High on the international agenda is achieving the compatibility and (where possible) interoperability of these systems. The IGS must continue to take a leading role in monitoring these systems and their developments, and in making readily available the results of its experience and expertise, in particular high-level research and applications using the GNSS signals.

The work of the IGS and its constituent elements has become even more relevant and timely, as major global issues like climate change, sea-level rise, disaster prediction, monitoring and mitigation (specifically, of earthquakes, tsunamis, and volcanic activity) gain greater prominence in advancing efforts to better understand, predict and protect the environment in which we live.

The purpose of the Strategic Plan is to place the IGS in a position to take advantage of inevitable changes and maximize its potential and utility in serving the scientific community and the public. The implementation of this Plan will be aided by the formulation and execution of annual implementation plans, in which the principal targets for the various elements and projects will be defined for each calendar year.

II. IGS Mission, Goals and Strategies 2008-2012

• MISSION

- ***The International GNSS Service provides the highest-quality GNSS data, products, and services in support of the Earth observations and research, positioning, navigation and timing, the terrestrial reference frame, ~~Earth rotation~~, and other applications that benefit society.***

To accomplish this mission the IGS has set six long-term goals. These goals are to:

1. Serve as the premier source of the highest-quality GNSS related standards (conventions), data and products, openly available to all user communities.
2. Attract leading-edge expertise to pursue challenging, innovative projects in a collegial, collaborative and creative culture.
3. Incorporate and integrate new systems, technologies, applications and changing user needs into IGS products and services.
4. Facilitate the integration of IGS into the Global Geodetic Observing System (GGOS) and other more broadly based Earth observing and global navigation systems and services.
5. Maintain an international federation with committed contributions from its members, and with effective leadership, management and governance.
6. Promote the value and benefits of IGS to society, the broader scientific community, and in particular to policy makers and funding entities.

• STRATEGIES AND ACTIONS

- In order to accomplish its mission and achieve its goals, the IGS has adopted three key strategies and associated specific actions required to move the IGS toward its long-term goals and to realize its mission.

Strategy 1

Deliver world-standard quality GNSS data and products to all users globally with leading-edge expertise and resources. (See Goals 1 and 2)

Actions needed:

Ruth Neilan 5/29/08 4:59 PM

Comment: Work in concept on IERS standards & conventions

Quality

Ensuring highest quality of GNSS data, products and services is the cornerstone of IGS philosophy, therefore the IGS will strive to:

- Maintain all IGS components at highest levels of quality and accuracy
- Compare, combine and validate IGS products
- Determine, publish and implement improvements required in the IGS network, hardware, software, analysis techniques and product dissemination

- An Infrastructure Committee will address site-related data quality and access to ITRF
- Engage with station operators, Analysis Centers, researchers and manufacturers to help design standards and conventions, and to train/assist future system builders
- Assess performance through IGS workshops, reviews, and other meetings
- Audit and report on areas requiring changes
- Obtain user feedback on the quality of services provided and report the results.

World standard

The IGS has served de-facto as the world's standard and must retain this position in order to best served it existing and broadening constituencies. The IGS will evolve and incorporate new and varied data-sets. In continuing as the world standard, the IGS will:

- Support participating agencies with standards for the transition to a multi-system tracking network
- Provide open access to data and products to meet the needs of IGS user communities.
- Identify and pursue innovative projects, and incorporate new technologies and systems.
- Promote the IGS as the standard via forums, workshops, education, and brochures.
- Determine user requirements, benefits received, and future needs through special sessions, user workshops, literature search, and university connections; respond with documentation for sponsors and users.
- Incorporate these user needs into the IGS through improved processes, products and services.
- Develop and distribute open-source, standard software tools for IGS users.
- Encourage researchers to cite IGS in journal publications.
- Expand outreach to new user communities and GNSS systems.
- Build partnerships and participation with governmental, educational and commercial entities.

Leading-Edge Expertise

The IGS is fortunate to have the dedication of the best minds, with demonstrated technical and scientific leadership. In order to continue to draw the best people to an increasingly diverse breadth of expertise, the IGS will:

- Attract leading-edge talent and new researchers by involving them in challenging science, innovative projects, and engaging with IAG commissions.
- Publicize involvement in innovative areas, working groups and projects.
- Pursue and engage new players, in different geographic, scientific, and application areas by including them in meetings and workshops, and through focused presentations.
- Create a 'Welcome' package highlighting key aspects of the IGS culture, including examples of IGS spirit of collegiality and collaboration.
- Utilize university members to serve as 'Ambassadors for IGS' within their universities to attract the interest of multi-disciplinary centers.

Strategy 2

Develop, integrate, and participate with new and changing GNSS systems and understand user needs to continuously improve IGS services and to provide value to a broad range of users. (See Goals 3 and 4)

Actions needed:

New systems and user needs

New GNSS systems, the modernization of existing systems and increasing number of users and applications will provide new opportunities, therefore the IGS will:

- Incorporate new systems and GNSS signals and technologies into IGS capabilities
- Build relationships and implement plans for GPS modernization, GLONASS modernization, Galileo, potentially COMPAS and other emerging systems and augmentations
- Initiate a Galileo Pilot Project (post 2009), pre-study Galileo signals by the GNSS Working Group in cooperation with analysis centers
- Establish strategic alliances and maintain continuing dialogue to ensure IGS will be integrated into broadly based Earth observation and GNSS organizations e.g. GGOS, ICG, GEOSS
- Feed IGS inputs into the GEO work plan via GGOS; screen the list of GEO tasks, which could lead to new innovative multi-disciplinary projects
- Define IGS role in GGOS. Formalize/promote interactions with IAG Services through GGOS
- Be a prime source of GNSS, multi-system monitoring, supported by corresponding system products
- Study and recommend a minimum set of signals (GPS, GLONASS, Galileo, ...) for scientific data processes
- Encourage data centers and analysis centers to confirm ability to store, distribute and analyze additional "evaluation sites"
- Increase IGS processing capacities
- Develop new classes of products in response to user needs (e.g. real-time products for tsunami, space weather, weather forecasting, timing products, products for global warming research, etc.).
- Build broader global participation with nations and regions not actively involved with IGS.
- Conduct joint projects with other services, user groups or organizations.
- Promote participation in IGS Real-time activities, encourage upgrade of IGS stations for RT data streaming; encourage use of real-time products/applications, and processes; engage with GNSS manufacturers; be proactive in standards development.

Development and Funding

Maintaining the current level of productivity while being responsive to a more complex range of opportunities and services will require additional resources. Therefore the IGS will:

- Promote the value of IGS as a primary source of high-precision GNSS information and to gain support for on-going funding, focus on benefits, provide justification, and identify activities that are of value to policy and decision makers.
- Broadly communicate this strategic plan through personal visits, newsletters, annual reports, e-mails, educational forums, workshops, and special sessions at meetings or workshops with users.
- Clearly identify funding sources and key decision makers. Invite them to special IGS events.
- Identify multi-year funding from its sponsors; identify and itemize IGS benefits, integrate with global initiatives (e.g. GGOS, ICG) to strengthen justification for commitments
- Raise funds for specific activities, e.g., travel, training, developing countries.
- Seek additional voluntary commitments from its members.

Strategy 3

- ***Continuously improve the effectiveness of IGS management and governance to support future growth*** (See Goals 5 and 6).

Actions needed:

Governing Board

The principal roles of the Governing Board (GB) are to set policy and to exercise broad oversight of all IGS functions and components. In developing the strategy to achieve the IGS goals in this plan, the Board placed emphasis to:

- Balance GB meetings between strategic direction and technical issues.
- Improve mechanisms for taking technical and administrative actions
- Continue policy of transparency and openness of GB discussions and decisions
- Ensure diversity of the GB with respect to geographical distribution and expertise (hydrology, meteorology, climate change, economics, public policy, legal, etc.)

Legal entity

As an international federation and scientific organization, the IGS does not have the presence as a legal entity, it is decided that it will:

- Investigate the establishment of a vehicle, such as an international non-profit corporation, to receive funds/donations for activities such as scholarships, grants, proposals, and sponsored travel to meetings.

Strategic Plan

For effective and guided growth to achieve the IGS mission according to the strategies laid out in this plan the IGS will:

- Establish a process to implement the Strategic Plan and monitor progress
- Establish annual implementation plans with assigned accountability

Central Bureau

The Central Bureau (CB) is the executive arm of the IGS Governing Board, responsible for the general management, coordination and day-to-day operations of the IGS consistent with the directives, policies and priorities set by the Governing Board. The demands on the Central Bureau outpace the available resources creating a balancing of priorities. The CB will

- Implement elements of the Strategic Plan, administer the Strategic Plan follow-up and action item progress
- Develop an annual operating plan with action items. Report on progress.
- Add resources to and/or decentralize functions by: Considering the assignment of specific CB functions to other members of IGS (CB to define functions), using visitors where feasible
- Develop sources for new and expanded funding

III. History of the International GNSS Service

The International GNSS Service (IGS) was established in January 1994 as a service of the International Association of Geodesy (IAG). The IGS was originally named the International GPS Service for Geodynamics. In 1999, the name was shortened to International GPS Service. The current designation was officially adopted in 2006, to reflect the fact that the satellite constellations supporting the work of the IGS are no longer limited to the United States Global Positioning System (GPS).

A number of key factors led to the formation of the IGS. By the late 1980's many geodynamics and geodetic organizations recognized the potential of the GPS. As the then-new GPS began to be used for research and science applications, many organizations recognized the economical and unprecedented level of positioning achievable with this technology. The motivating goal for the solid Earth sciences was millimeter-level positioning in support of science anywhere in the world. However, it soon became apparent that no single entity could (nor should) assume the capital investment and recurring operations costs for such a global system. It was at this point that key international players first considered joint partnerships to define cooperative approaches and set standards, to ensure that this endeavor would be successfully developed and ultimately driven by quality of science.

The idea for an international GPS service began to crystallize at the 1989 International Association of Geodesy (IAG) Scientific Assembly meeting in Edinburgh, United Kingdom. It was here that it was recognized that a standardized civilian system for using GPS would be beneficial to all. Subsequently a planning committee was established within IAG.

In 1991, a Call for Participation was organized by this IAG Planning Committee, seeking participants and contributors who would develop a "proof of concept" of an international service. It requested interested groups to assume the role of station operations, networks, data centers, analysis centers and a Central Bureau for coordination of the activity. The response was overwhelming and the International GPS Service Oversight Committee was formed at the International Union of Geodesy and Geophysics (IUGG)/IAG General Assembly meeting in Vienna in 1991. This Committee organized a pilot project to demonstrate the potential of an international service based on the GPS. The pilot activity took place from June to September 1992 and was highly successful. The IGS was thus determined to be clearly viable. The IGS Pilot Project continued through 1993, while a proposal was prepared to the IAG seeking approval for the IGS as an IAG international service. Approval was received at the IAG Scientific Assembly in Beijing in 1993, and IGS was officially established on January 1, 1994. Recognition of the value of IGS was reinforced with membership in the Federation of Astronomical and Geophysical Data Services (FAGS), initiated in 1996.

The IGS, as a completely voluntary organization, continues to operate the global civilian GPS tracking system for science and research. Since the pilot project in 1992, the network has grown from approximately 30 permanent GPS stations to more than 350; and the accuracy of the IGS orbits has improved an order of magnitude, from 50 cm to better than 5 cm. The IGS continues developing and improving traditional products such as orbits, clocks, station positions and velocities, as well as fostering projects and working groups that produce additional data products, such as precipitable water vapor (PWV), and total electron content (TEC). These IGS projects and working groups are dependent upon the infrastructure of the IGS for science applications. The projects and working groups have included: Precise Time And Frequency Project joint with the Bureau International des Poids et Mesures (BIPM), the Ionosphere Working Group, Troposphere Working Group, IGS Reference Frame Working Group, the International GLONASS Pilot Project (IGLOS-PP), the LEO Pilot Project/Working Group, the Tide Gauge Benchmark Monitoring Project for the sea level studies (TIGA), the GNSS Working Group and the Real-Time Working Group.

It is the infrastructure of the IGS, and in particular the efforts of the IGS Analysis Centres, that have driven the evolution and improvements of the IGS that in turn support these science driven applications. Through these working groups, the IGS continues to evolve and improve. The IGS has become the primary source for general access to and continuous development of the precise reference frame of the International Earth Rotation and Reference Frame Service (IERS): the International Terrestrial Reference Frame (ITRF). The IGS has become the global framework for virtually all regional applications and networks, including the following: Southern California Integrated GPS Network (SCIGN), IAG Commission X - Global and Regional Geodetic Networks, Sub-commission for Europe (EUREF), Sistema de Referencia Geocéntrico para América del Sur (SIRGAS, the South American continental reference system), etc.

IV. Roles of IGS Components

The history, development, and current status of the IGS are captured in the Annual and Technical Reports, and workshop proceedings, all maintained and available through the Central Bureau. Key documents such as the IGS Terms of Reference, and including all publications, are held at the IGS information system at the Central Bureau. See: <http://igsch.jpl.nasa.gov>.

Associated with the IGS Terms of Reference 2005 are Charters for Analysis Centres and Data Centres and a Policy for the establishment of Working Groups and Pilot Projects.

The IGS components are:

Network of Tracking Stations

All components of the IGS are critically dependent on the global network of precise GPS tracking stations. Recognizing the fundamental requirement for consistent, coordinated, and high-quality network operations, where different receivers are fielded by more than 50 organizations, the IGS Governing Board recommended in late 1997 that a Network Coordinator be established. This was realized in 1998 when a position was created within the Central Bureau. Since then an overall enhancement of the network processes has been realized. The IGS network includes over 350 stations that operate continuously, delivering data hourly or daily to the data centers. A subset of the network is providing real-time data streams within the IGS Real-Time Pilot Project. The IGS network today also includes over 50 GLONASS tracking stations.

Data Centers

Since the inception of the IGS, the archives of the data centers have become increasingly important to a wide range of scientific and research applications. The distributed nature of the data flow supporting the IGS has been key to the successful archiving and availability of both IGS data and products. A hierarchy of data centers distributes data from the network of tracking stations, the Operational, Regional and Global Data Centers. This scheme provides for efficient access and storage of GPS and ancillary data, thus reducing network traffic as well as providing a level of redundancy allowing for security of the data holdings. There are four Global DCs, six Regional DCs and 16 Operational DCs.

Analysis Centers, Analysis Coordinator and Associate Analysis Centers

The Analysis Centers (AC) are the scientific backbone of the IGS. They provide, based on the available tracking data of the whole IGS network, a consistent set of high quality products such as precise satellite orbits, station and satellite clock information, station coordinates, Earth rotation parameters and atmospheric information. To fulfill the tasks of an IGS AC, all products have to meet the highest standards according to the IERS Conventions and, just as stringent, all submissions have to be made available on time and on a regular basis. Currently, the IGS ACs offer three types of solutions which differ in accuracy and latency to many kinds of scientific and engineering applications, specifically: weekly final, daily rapid, and sub-daily ultra-rapid products. Besides their routine work, the ACs permanently concentrate on a variety of model improvements and these activities are the driving forces of the success of the IGS. There are currently ten ACs.

The ACs work with the Analysis Coordinator, who ensures that the IGS objectives are executed. Specific responsibilities of the Analysis Coordinator include quality control, performance evaluation, and continued development of appropriate analysis standards. The Analysis Coordinator is also responsible for assembling the Analysis Centers' output into a single set of products.

Associate Analysis Centers are organizations that produce specialized products, (e.g., ionospheric information or station coordinates and velocities for a global or regional sub-network) and are generally linked to an IGS pilot project or working group. There are 20 of these Associated Analysis Centers.

The work of supporting and developing the three IGS components is carried out by Working Groups that are tasked with the execution of various Pilot Projects.

Working Groups and Pilot Projects

Working Groups focus on selected topics related to the IGS components according to goals and schedules specified in the working group's charter. Pilot Projects aim to develop particular IGS product(s) or service(s) that rely on the IGS infrastructure.

At present, the current IGS Working Groups are:

- Ionosphere Working Group
- Troposphere Working Group
- IGS Reference Frame Working Group
- Low Earth Orbiter (LEO) Working Group
- GNSS Working Group
- Data Center Working Group
- Clock Products Working Group
- Calibration and Biases Working Group
- Antenna Working Group

The current IGS Pilot Projects are:

- Tide Gauge Benchmark Monitoring Project for the Sea Level Studies (TIGA)
- Real-Time Pilot Project

Previous Pilot Projects, which were concluded successfully and integrated into the mainstream IGS activities, were:

- Precise Time and Frequency Project, jointly with the Bureau International des Poids et Mesures (BIPM)
- International GLONASS Service Pilot Project (IGLOS=PP)

The management of the IGS components, Working Groups, and Pilot Projects is overseen by the following policy and executive bodies:

IGS Governing Board

The principal roles of the Governing Board are to set policy and to exercise broad oversight of all IGS functions and components. It also controls general activities of the Service, including re-structuring, that would be appropriate to maintain efficiency and reliability, while taking full advantage of the advances in technology and theory.

Central Bureau

The Central Bureau is the executive arm of the IGS Governing Board and as such is responsible for the general management and coordination of IGS activities and external affairs of the IGS consistent with the directives, policies and priorities set by the Governing Board.

